Minutes of the meeting of SPIRAL2 Scientific Advisory Committee (SAC) held in Caen on 26-28 January 2011

Present: N. Alamanos, B. Blank, G. De Angelis, W. Gelletly, D. Guillemaud-Mueller, M.N. Harakeh (Chair), W. Henning, W. Mittig, T. Motobayashi, D. Vernhet
Ex-officio: N. Alahari, S. Galès, M. Lewitowicz
Absent with notification: F. Iachello, B. Jonson, H. Stöcker

The SPIRAL2 SAC met on January 26-28 in Caen, both at the Memorial and at GANIL (see Appendix 1 for the programme of the open and closed sessions). In the open session, a report on the inauguration of FUSTIPEN (French-US Theory Initiative on Physics of Exotic Nuclei) was given and status reports on S3, NFS and HELIOS were presented. This was followed by presentations of the letters of intent (LoIs) for day-one experiments of Phase 2 of SPIRAL2. The SAC was impressed by the number of LoIs submitted (53 in total; one was withdrawn two days before the SAC open sessions) indicating a very strong interest and commitment by the community to use the state-of-the-art facilities that will become available when Phase 2 of SPIRAL2 is completed and the excellent scientific opportunities this will create.

During the presentation of the status reports of S3, NFS and HELIOS, the SAC was pleased to see the progress made with S3 and NFS, which will become the workhorses of research with the start of Phase 1 of SPIRAL2. Also, the SAC was glad to hear that the S3 application to "EquipEx" (Equipment of Excellence) was successful. However, only about half of the full budget for building the equipment was granted. Though this agreed budget will provide for a serious start for the S3 project, the SAC strongly advises both the S3 project group and the GANIL Directorate to continue looking for (inter-)national possibilities of securing the complete budget to ensure a full realisation of S3 together with its detection systems and ancillary equipment. The SAC was also pleased to hear about the strong commitment of the Swedish partners at Uppsala University to contribute to the NSF facility. This will enrich the scientific programme with the NSF facility. The SAC took note of the fact that DESIR's application for EquipEx was not successful this time around but that it took a high position making its chances of success higher in the second round expected this year. Therefore, the SAC encourages the DESIR collaboration to submit the application again through its French partners and to strengthen further the financial commitment of its non-French partners.

The status reports that were presented in the open session were considered together with the 52 LoIs for day-one SPIRAL2 Phase 2 experiments submitted by different collaborations. The reports on the recommendations, agreed upon during the closed SAC session are given below.

Closed session

1. *Short Status report on SPIRAL2 and statistics of LoIs*

At the beginning of the closed session, Marek Lewitowicz, SPIRAL2 scientific coordinator, gave a brief report on the various developments with SPIRAL2 and the timeline for various steps in the future. He also presented some statistics on the submitted LoIs concerning the themes and subfields of research, types of beams requested and equipment to be used. A discussion ensued

regarding the necessary solutions for the measurement of recoils in transfer and fusion evaporation reactions, and the requirements on the operation of VAMOS. The SAC decided that it should receive the "GANIL 2015" report where many of these points were discussed. Navin Alahari will write a one-page document clarifying these issues. The SAC will include this as an appendix to its minutes (see Appendix 2). Furthermore, this topic might be put on the agenda of the next joint meeting of the SAC and the Scientific Council of GANIL (end of September 2010).
The bunching of radioactive beams at the exit of the CIME cyclotron in order to improve the time resolution for the benefit of certain experiments was discussed briefly. After a preliminary analysis carried out by GANIL, this issue, which requests important additional resources, was not considered by the GANIL management to be of the highest priority.

The SAC strongly recommends that the GANIL Directorate works together with the DESIR collaboration to ensure that funds are obtained for building the DESIR experimental hall.

2. *Evaluation of the S3, NFS and HELIOS status reports*

S3 status report (H. Savajols):

The SAC congratulates the team for being essentially on track with the conceptual design for the S3 spectrometer. Many different options were carefully investigated and in much detail. The experts that were consulted agreed with the solutions that were selected. There is only one item left where the final selection is still open, *i.e*. the choice of the quadrupole triplet near the beam dump. The SAC recommends that this choice be made as soon as possible, in order to have final versions for all the hardware components.
The SAC was pleased to hear that the team has received an important part of the funding through EquipEx, with an allocated amount of 8 M€. The SAC encourages the Directors of GANIL and the S3 team to pursue additional sources for financing the missing funds. While waiting for full funding, it may be useful to establish a "phase-0" programme that would describe what can be achieved with the EquipEx funding alone, and with the remaining funding needed to realise the full scope of the device at a later stage. The financing for the atomic physics programme should also be clarified soon.
Some general ideas for the detection systems that could be associated with S3 have been presented. It is timely now to enter into more detailed considerations, and to have a special report on this subject for the next meeting of the SAC.

Neutrons for science (NFS) status report (X. Ledoux):

The SAC notes that the construction progresses well but it should be actively pursued for a timely completion of the equipment. The SAC was also pleased to hear about the strong commitment of the Swedish partners at Uppsala University to contribute to the NFS facility. This will enrich the scientific programme with the NFS facility.
The second NFS neutron beam line could be simulated fully. The SAC finds that the solution with two experiments performed simultaneously is still valid.
The SAC notes that collaboration with the n-TOF/CERN community is not yet as strong as expected. The report submitted to the SAC was very short and non-exhaustive. Fortunately, the oral presentation was more detailed.

Concerning the CIRIS2 project no LoIs were submitted up to now but this option is preserved.
The recommendations of the SAC are the following: Simulate the background in the detectors and more generally optimise the facility.

HELIOS status report (B. Kay):

The HELIOS project was presented for the second time to the SPIRAL2 SAC. The SAC welcomes the new results obtained for heavier nuclei with HELIOS at Argonne National Laboratory which indicate the feasibility of experiments also with neutron-rich fission products at SPIRAL2. As already stressed last time, the SAC requests that the HELIOS collaboration works out in a more elaborate LoI the complementarity of HELIOS with respect to setups already proposed and in their construction phase, like GASPARD and ACTAR. This work could be done in collaboration with these groups. Simulations should also be performed with realistic beam emittances to get efficiency curves, resolutions etc. In addition, the use of cryogenic targets should be investigated. The possibility to shift the target to the exit of the solenoid to allow for γ-ray detection could be looked into. Finally, the option to move HELIOS from the G2 to the G1 cave to install it in front of VAMOS (or in G3 in front of SPEG) should be investigated.
In addition, the SAC encourages the HELIOS collaboration to investigate all possible routes for funding.

3. *Discussion of strategy and procedure of evaluation of LoIs*

A discussion was opened concerning the strategy and procedure for evaluation of the large number of LoIs. Different opinions were presented by the SAC members but finally consensus was arrived at with the recommendation that although the LoIs should be evaluated and discussed separately, they should be grouped according to topics. Within each group, the spokespersons should consolidate the LoIs in some sort of a programme with probably more than one spokesperson. The groups should discuss together the optimisation of the science case(s) and the experimental setups. The SAC expects consolidation of these programmes and agreement among the collaborations formed on a short list of the day-one experiments for Phase 2 of SPIRAL2 to be presented during the following round of the evaluation by SAC.

The SAC recommends clustering of the LoIs around the following global topics:
Mass measurement with traps: 1, 2, 4, 8, 10
Exotic decays: 3, 13, 45,
Nuclear Moments (*except laser techniques*): 29
Laser spectroscopy: 5, 6, 11, 12, 14, 16
Beta-decay: 7, 15, 17, 19, 20, 52 (50%)
Astrophysics: 9, 30, 35, 37, 43 (50%), 46, 47, 48, 52 (50%), 53
Gamma spectroscopy & Coulex: 21, 24, 26, 27, 32, 51
Fusion reactions & collective modes: 22, 23, 25, 28, 38
Haloes & Structure in the Continuum: 31
Cluster structures: 39
Shell structure near magic numbers (*with direct reactions*): 33, 34, 36, 42, 43 (50%), 44, 49, 50
Isospin in nuclear reactions and hot nuclei: 40, 41

4. *Evaluation of the LoIs*

LoI_SP2_Ph2 1: Precision mass measurements of nuclei with $Z \sim 104$ from S3 with MLLTRAP at DESIR
P. G. Thirolf *et al.*

The SAC is convinced that the measurement of masses with the MLLTRAP at DESIR will be an important part of the experimental programme at SPIRAL2. The measurement of masses for the heaviest elements is clearly an important ingredient in studies of nuclei in this region, given that it will provide anchor points for the masses of the nuclei observed to alpha decay and fission in the characteristic decay chains observed in such studies. The SAC urges the community involved in mass measurements to ensure that they are fully prepared for day-one of SPIRAL2, Phase 2 and that they have prioritised their various projects.

LoI_SP2_Ph2 2: High-precision determination of the half-lives, branching ratios, and Q values of superallowed β decays in ^{66}As and ^{70}Br with BESTIOL and MLLTRAP at DESIR
C. Weber *et al.*

This proposal aims at high-precision studies of superallowed (0^+ to 0^+) β decays of the self-conjugate ^{66}As and ^{70}Br nuclides for the purpose of providing tests for the hypothesis of conserved vector current (CVC). These studies will further extend the data set for determination of the matrix element V_{ud} of the Cabibo-Kobayashi-Maskawa (CKM) quark-mixing matrix with the aim of testing the unitarity of its first row. Very precise measurements of half-lives, $T_{1/2}$, of the mother nuclides and also the branching ratios, in order to determine the partial half-lives of the superallowed transitions, are envisaged. These measurements will be performed with the BESTIOL facility consisting of a Penning trap to collect isotopically pure samples of ^{66}As and ^{70}Br and deposit them on a tape that will be positioned at the centre of a measuring facility. High-accuracy measurements of the masses of the mother and daughter nuclides are also envisaged with the MLLTRAP Penning trap mass spectrometer. This will yield high-precision β-decay Q-values. The proposed experimental procedures are state of the art, and the proposed experiment is certainly a very good candidate for a day-one experiment of SPIRAL2 Phase 2. This experiment could also become the initiation of a programme that will be extended to the measurement of β decay of heavier self-conjugate nuclei in the future.
The stress in this LoI is on the test of unitarity of CKM matrix. However, this is already known to be true to a high accuracy and the proposed measurements cannot improve on this accuracy. This is due to the large uncertainty in the nuclear-structure correction term. One can reverse the goal of these studies by using the unitarity of the CKM matrix to investigate the validity/accuracy of the microscopic nuclear-structure calculations.

LoI_SP2_Ph2 3: Search for cluster radioactivity in the region above ^{100}Sn
B. Blank *et al.*

The emission of ^{14}C cluster radioactivity observed by Rose and Jones in ^{223}Rn [Nature **307** (1984) 245] prompted a programme to study this type of decay over a wide range of isotopes. The present LoI aims to the characterisation of the ^{12}C cluster decay in the region of ^{114}Ba and possibly ^{112}Ba, the first step being the Q-value determination obtained through the identification

of α-decay. The SAC finds the LoI well structured and focused. The proposed region is well chosen even if the main objective is very challenging (^{12}C cluster decay) and certainly not well suited for a day-one experiment. The SAC finds appropriate the proposed staging of the project focused on the identification of the Q-values through the (more probable) α-decay. Once this is known, the ^{12}C Q-value can be determined and consequently also the expected partial half-lives and branching ratios can be evaluated.
The SAC suggests that the proponents consider also other possible decay channels as, for example, the branching ratio due to ^{8}Be cluster emission. Also, the detection setup could be more clearly defined as well as the feasibility of the two-step reactions.

LoI_SP2_Ph2 4: The mass of ^{100}Sn and the extraordinary binding of $N = Z$ nuclides
D. Lunney, P. G. Thirolf *et al.*

The SAC is convinced that the measurement of masses with the MLLTRAP at DESIR will be an important part of the experimental programme at SPIRAL2. The doubly-magic ^{100}Sn nucleus and its neighbours should be produced with good intensities at SPIRAL2 and the measurement of their masses is important for a variety of reasons including their importance in terms of the *rp*-process of astrophysics, understanding the Wigner energy, etc. The proponents should ensure that they are fully prepared for Day One of SPIRAL2, Phase 2. The SAC looks forward to future reports on the detailed progress of plans to install the trap at DESIR.

LoI_SP2_Ph2 5: Nuclear structure and electron shake-off in strontium, yttrium and zirconium
P. Campbell *et al.*

The aim of the proposed experiment is to study by laser spectroscopy techniques, at the LUMIERE facility, the structure of nuclei in the yttrium (Z=39) region. In this region, very large changes in deformation in the isotopic chain are predicted theoretically and deserve experimental investigation.
The proposal is based on the ability of the proponents to exploit the "shake off" process in which ionic charge states can change following nuclear beta decay. Indeed, this process can be extremely valuable, in temporally separating the "decayed" species following a suitable flight time to the LUMIERE station. The success of the foreseen experiments is based on a direct yttrium production of the order of 10^2/s. Such production rates can be achieved only with the development of laser ion sources.
The SAC welcomes the proposal and suggests to the proponents to strongly interact with colleagues working on the development of laser ion sources in order to help in these developments.

LoI_SP2_Ph2 6: Charge radius change and nuclear moment measurement in the N=50 and N=104 region using the LUMIERE setup at the DESIR facility
F. Le Blanc *et al.*

With collinear laser spectroscopy, one can essentially measure the nuclear magnetic and quadrupole moments as well as the change in the mean-square charge radius independently from nuclear models.

A laser beam is sent collinearly with an atomic beam of the same size, such that they can resonantly interact. The laser frequency is scanned in order to record the complete hyperfine spectrum from which one can extract the nuclear quantities.
It is foreseen to produce the exotic species by two different methods:

i) either from the SPIRAL2 fission source coupled to a high-resolution mass separator and RFQ, from which low-energy beams can be sent into the DESIR setups for further measurements,
ii) or alternatively by using fusion-evaporation reactions with the very intense stable beams from the SPIRAL2-LINAG. The reaction products will be separated from the primary beam with the S3 super separator spectrometer and sent to the DESIR setups.

Obviously the proponents have in mind different experimental schemes in order to produce exotic beams. However, many of the envisaged equipments are under construction and some of them probably not yet financed.
The SAC suggests to the proponents to closely follow up the ongoing technical developments in order to render these experiments feasible.

LoI_SP2_Ph2 7: Neutron monopole drift towards ^{78}Ni investigated by gamma-spectroscopy following ^{81}Cu beta-decay
D. Verney *et al*.

The proposal concerns one of the regions of the nuclear chart of strong interest for SPIRAL2. It aims to study the single-particle structure in ^{81}Zn through measuring the β decay of ^{81}Cu to ^{81}Zn. It will be possible to measure the half-lives and the delayed neutron probabilities following the β decay chain. The sequence of levels will also be determined. This information may be compared to model calculations and fitted to deduce the single-particle structure. The results are an important input for *r*-process network calculations.
The experimental device BEDO is simple. It is based on a movable tape and a gamma-detection system. This is constructed at IPNO and can be fully tested at ALTO. This makes this proposal well suited for a day-one experiment.

LoI_SP2_Ph2 8: High precision measurements in mirror beta decays to test the CVC hypothesis and the CKM unitarity
E. Liénard *et al*.

This LoI addresses the CVC hypothesis and the unitarity of the Cabibbo-Kobayashi-Maskawa (CKM) mixing matrix. The latter has been proven to be verified to a great precision by accurate measurements of superallowed β-decays and analysed in great detail by Hardy and Towner over many years. The LoI aims to confirm this result probing mirror decays. It uses mirror transitions between T=1/2 isospin doublets pointing, in particular, to the determination of the GT/F mixing ratio.
The SAC finds the use of this methodology very interesting even if some concerns exist on the possibility of reaching the precision needed to reduce the uncertainty on the unitarity. With the proposed setup (BESTIOL, PPCTrap and MLLTRSAP) at DESIR it is planned to make high-precision measurements of half-lives, branching ratios and masses for mirror decays. It is also proposed to determine GT/F mixing ratios from correlations. The SAC finds the idea to make a unique database very interesting and useful not only in the context of the CVC/CKM work,

which seems to be basically settled, but also for future understanding of the isospin symmetry breaking and of the radiative corrections needed to deduce the Ft values.

LoI_SP2_Ph2 9: Half-life and binding-energy measurements for rapid-neutron-capture nucleosynthesis
T. Kurtukian-Nieto, D. Lunney, P. G. Thirolf *et al.*

The LoI aims to study the structure of neutron-rich nuclei close to shell closures for providing information on development and time scale of stellar nucleosynthesis processes. Main objectives are the measurements of half-lives and masses of neutron-rich nuclides in the region of N=50 and N=82. The SAC finds the physics motivation of high interest and the proposal well written but encourages the group to provide a more elaborated theoretical description in particular for what it concerns the impact on the astrophysical scenario.
The SAC appreciates the focus of the LoI on the nuclei of interest also from the point of view of testing nuclear models. For example, the $^{81-83}$Zn nuclei are of interest for understanding whether or not the closed shell at N=50 survives as Z decreases, and the $^{139-142}$Te nuclei are of interest to understand the onset of deformation (if any) at N=90.
Since this proposal qualifies for day-one experiment, the SAC also encourages the group to define the priorities for the proposed cases.

LoI_SP2_Ph2 10: Study of quantum phase transitions around A = 100 from the nuclear mass surface
D. Lunney, P. G. Thirolf *et al.*

The LoI aims to study the shape phase transitions in nuclear systems through the determination of the masses. In particular, it aims at the investigation of the neutron rich Kr, Rb, Sr and Y isotopes produced by the SPIRAL2 facility. The precise determination of the masses for the proposed isotopes is expected to shed new light over quantum phase transitions between different nuclear shapes. The SAC finds the aim of the LoI interesting and worth to be pursued. It seems probable that more detailed spectroscopy will help or will be needed to establish this phase transition.
This LoI is cited as being complementary to LoI 15, which will establish decay schemes, and hence this complementarity should be elaborated with respect to theoretical and practical aspects. The SAC also encourages the proponents to submit a proposal with a more elaborated theoretical description. Concerning the experimental setup, once the MLL trap is installed at DESIR and is operating, the experiment as such seems to be rather feasible.

LoI_SP2_Ph2 11: Collinear laser spectroscopy of neutron deficient isotopes of Ag and Sn across the N=50 shell closure
M. L. Bissell *et al.*

Measurements of mean-square charge radii, $\langle r^2 \rangle_c$, ground-state spins, magnetic and quadrupole moments are useful to provide information for determining the structure of nuclei. The region around N=Z=50 lacks this information. This is a worthwhile experiment, especially if the tin isotopes $^{100-110}$Sn can be measured. The study is unique and competitive among proposed DESIR experiments. Whether or not this is a day-one experiment depends on technical developments including the beam purification.

LoI_SP2_Ph2 12: Beta-delayed spectroscopy of laser-polarised beams
D. T. Yordanov *et al.*

This LoI relies on the development of the technique of β-delayed spectroscopy on laser-polarised beams. This method will extend the possibilities of collinear laser spectroscopy by introducing the capability of measuring spins and parities of excited nuclear states in addition to the spin, moments and charge radius of the ground state.
The proposed measurement is dedicated to the nuclei in the vicinity of the doubly magic ^{132}Sn where DESIR will excel with high beam intensities. Considering the current yield predictions, the measurements of the neutron-rich tin isotopes can be extended well beyond N = 82 allowing one to shed additional light on the restoration of the shell gap inferred from the mass measurements of ^{132,134}Sn and to reveal the characteristic shell effect on the radii. This very ingenious method is well suited for the DESIR installation and will provide a very sensitive tool for studying nuclear decays.
The SAC welcomes this proposal of high scientific interest and suggests that the proponents should, in due time, submit a proposal to the SPIRAL2 PAC.

LoI_SP2_Ph2 13: Beta-delayed two-proton emission studies
P. Ascher, J. Giovinazzo *et al.*

The proponents have important experimental contributions in the domain of two-proton decay of exotic nuclei. The aim of the proposal is to extend these studies to decays from excited states of exotic nuclei and study the 2*p* direct branch which up to now has never been evidenced. Two-proton emission from excited states is not only much easier to observe experimentally but also a more favourable case for studies of the emission mechanism. Indeed, exotic 2*p* decay can be either a sequential emission via an intermediate state or a simultaneous emission of the two protons. While for ground-state emission, the proton-proton correlations may be affected when tunnelling through the Coulomb barrier, this should be less the case when the emission occurs from an excited state.
A high-efficiency charged-particle detector has been developed by this group to search for such correlated 2*p* emission. It is expected that with this set-up the study of ^{31}Ar or other β-2*p* candidates like ^{26}P, ^{22}Al, ^{27}S, ^{23}Si or ^{35}Ca will be possible at the DESIR facility with beams coming either from SPIRAL1 via fragmentation or from SPIRAL2.
The SAC welcomes this proposal of high scientific interest and suggests to the proponents to submit, in due time, a proposal to the SPIRAL2-PAC.

LoI_SP2_Ph2 14: Study of intruder configurations in the neutron-rich Co isotopes
T. E. Cocolios *et al.*

The experiment addresses the single-particle structure in neutron-rich cobalt nuclei at the *Z*=28 shell closure. Specifically, spin and magnetic moments will be measured by collinear laser spectroscopy at LUMIERE for $^{61-69}$Co to identify the ground state configurations, and perhaps also those of the recently identified isomeric (intruder) states at LISOL which are considered of 1p2h character. The proposed experimental configuration may include in-trap decay of laser-ionised manganese isotopes held by the RFQ buncher until the neutron-rich cobalt isotopes are populated.

While some of the experimental aspects, such as the holding-trap procedure, need to be explored and established, the proposal team brings the technical competence to carry out these studies. To carry out these experiments requires the significant intensities of the radioactive nuclei that SPIRAL2 will provide. Nevertheless, given the high nuclear physics interest in this region of the nuclear chart there is probably a non-negligible probability that some of these studies will have been performed at the time of SPIRAL2 Phase 2.
From the nuclear physics point of view this is an important contribution to the ongoing extensive studies of the neutron-rich N=40 region as it brackets the Z=28 proton shell closure. These studies have provided specific spectroscopic information as well as important insights into effective interactions. The N~40 nuclei straddle the region between the filled *fp* neutron shell and the open $g_{9/2}$ neutron shell. It has been often argued that the mean field for very neutron-rich nuclei leads to very diffuse surface density. This in turn leads to reduced spin-orbit forces, strong coupling to the continuum and high sensitivity to the spin-isospin part of the nucleon-nucleon interaction, in particular, the monopole parts of the tensor force. In the specific situation for the N~40 region one expects, when removing protons from the $f_{7/2}$ shell, the monopole pairing interaction to weaken. As a consequence, for the attractive $\pi f_{7/2}$-$\upsilon f_{5/2}$ interaction this is moving the $\upsilon f_{5/2}$ state up in energy and, because of the weakening of the $\pi f_{7/2}$-$\upsilon g_{9/2}$ repulsive interaction, bringing down the $g_{9/2}$ neutron state, leading to enhanced collectivity, deformations and rotational excitations. Clearly, a careful study of the nature of the single-proton hole in the $f_{7/2}$ shell (and the possible proton intruder isomer) will provide important information on the overall nuclear structure in this interesting mass region.

LoI_SP2_Ph2 15: Decay spectroscopy of the very neutron-rich Kr isotopes at SPIRAL2-DESIR
F. Delaunay, L. Achouri *et al.*

The LoI aims at the determination of the β-strength functions for the chain of krypton isotopes in the range $^{93\text{-}100}$Kr. The main focus concerns the investigation of the evolution of the deformation in that mass region and of the impact of the deformation on the astrophysical scenario. Those neutron-rich isotopes in fact lie on the path of the astrophysical rapid neutron-capture process.
The SAC finds the aim of the proposal interesting and the specific physics goal well chosen. The SAC also encourages the group to submit a proposal with a more elaborated theoretical description in particular related to the impact of the deformation on the astrophysical scenario. Moreover, since this LoI is linked to LoI 10, the SAC encourages the proponents to coordinate their experimental efforts.
Since the equipment is basically available (gamma detectors from EXOGAM and scintillation modules from LPC for neutron detection), the experiment is definitively feasible. The SAC also encourages the group to submit a detailed proposal addressing the priorities for the day-one experiment.

LoI_SP2_Ph2 16: Charge structure of manganese and iron isotopes as proton separation energy approaches zero
P. Campbell *et al.*

The SAC believes that SPIRAL2 will provide excellent opportunities for measuring nuclear charge radii. The case presented here for measurements of the charge radii of neutron-deficient Mn and Fe isotopes is a compelling one and will certainly make an excellent basis for a proposal for beam time in due course. The unusual behaviour of these nuclei is worthy of detailed

attention. No doubt there is already much discussion and preparation amongst the community involved in such measurements within the context of DESIR. The SAC would urge the community to move as rapidly as possible towards detailed planning of LUMIERE and to consider which of their projects should have priority on Day One.

LoI_SP2_Ph2 17: Decay spectroscopy studies around ^{110}Zr at DESIR
S. Grévy *et al.*

The aim of this experiment is to investigate the structure of exotic nuclei close to the ^{110}Zr nucleus which has 40 protons and 70 neutrons. ^{110}Zr is a key nucleus in studies of shell effects and in particular on the possible vanishing of the spin-orbit interaction far from the stability line. Recent theoretical predictions indicate that shell-gaps comparable or even larger than those at spherical shapes may exist in nuclei characterised by the double-tetrahedral symmetry group. The predicted tetrahedral "magic numbers" include $Z = 40$ and $N = 40$, 56, 70 nuclei.
As this nucleus (^{110}Zr) will most likely not be extracted from the thick targets of SPIRAL2, a first hint of the shell evolutions towards ^{110}Zr could be obtained by studying at the DESIR facility neighbouring nuclei which will be accessible within the SPIRAL2 project.
Different experimental strategies are envisaged by the proponents depending on the production rate and the half-lives of the isotopes to be studied.
The SAC welcomes this proposal which is of important scientific interest and requests the proponents to submit in the next SPIRAL2-SAC meeting a proposal specifying the production rates and the expected isobaric contamination rates for the nuclei to be studied.

LoI_SP2_Ph2 18: Exploring the transition from order to chaos in the neutron deficient nuclei from $28 \leq Z < 50$
M. J. G. Borge *et al.*

This LoI was withdrawn before presentation.

LoI_SP2_Ph2 19: Beta strength measurements in the ^{100}Sn region
A. Algora, B. Rubio *et al.*

The aim of this LoI is to study the beta decay of nuclei in the vicinity of ^{100}Sn with the total absorption technique (TAS), in particular ^{101}Sn, ^{98,99,101}In, and ^{97,98,99}Cd .
These studies are of great relevance concerning the shell structure of nuclei in the vicinity of $Z=N=50$ closed shell and the possibility of studying the heaviest accessible $N=Z$ nucleus ^{100}Sn; also the study of the quenching of the Gamow-Teller (GT) resonance is foreseen.
The proposed measurements are complementary to high-resolution studies and can provide B(GT) distributions in the daughter nuclei free from the Pandemonium effect.
For this kind of experiments, both the TAS spectrometer and the neutron BELEN counter will be used. Since they have no capacity to discriminate between isobaric beam contaminations, it is necessary to use the BESTIOL Penning trap as a high-resolution separator. This will enable selection of pure beams of the species under investigation. Moreover, in order to minimise counting losses due to the short half-lives, DESIR beams will be implanted on a movable tape at the centre of the spectrometer, before removing the activity to limit the contribution of the daughter products.

The SAC welcomes this complete proposal which combines different measurements with different setups. One of the inevitable problems of this kind of studies is the problem of contamination of the descendant activity which is obviously well known by the proponents and but has to be simulated.

LoI_SP2_Ph2 20: Beta strength measurements around the doubly-magic neutron-rich ^{78}Ni
J. L. Tain, B. Gomez-Hornillos *et al*.

This letter of intent is another example of the generated interest for β-decay studies of exotic nuclei and in particular of those close to shell-model magic numbers. It is focused on the study of the β-decay properties of nuclei in the vicinity of the doubly magic nucleus ^{78}Ni. These nuclei may contribute to the *r*-process path in which β-decay plays a significant role in determining abundances in the synthesis of elements and the speed of the process.
The species under investigation will be selected with the BESTIOL penning trap. The Valencia-Surrey spectrometer will be used for the measurement of γ rays and the BELEN 4π-neutron counter for the measurement of neutrons emitted from states located above the neutron separation energy of the daughter nucleus. The combination of these measurements should provide the full β-decay strength intensity distribution. Characteristics of the different experimental equipments are discussed in the proposal.
One of the inevitable problems of this kind of studies is the problem of contamination of the descendant activity, *i.e*. γ–rays produced by inelastic scattering or capture reactions or an important neutron background.
The SAC welcomes this proposal and asks the proponents to carefully simulate the background to ensure the feasibility of the experiment.

LoI_SP2_Ph2 21: Coulomb excitation of neutron-rich Te, Sn and Xe nuclei beyond the *N*=82 shell closure
W. Korten, M. Zielinska *et al*.

The experiment proposes to use the so-called "safe" Coulomb excitation exploiting the unique performances which should be available at SPIRAL2 (i.e. high-intensity beam of high energy impinging on heavy targets). This could demonstrate where SPIRAL2 has an important role to play compared to HRIBF in Oak Ridge and REX-ISOLDE at CERN, where experiments of this type were first performed. There are three distinct parts in the LoI and, as mentioned by the proponents, the final choice will depend on the beam availability on day-one of SPIRAL2 operation: (*i*) The Te nuclei seem to provide a simple and excellent day-one experiment. The B(E2) values in ^{136}Te and in ^{138,140}Te will be reachable, as well as possibly higher lying states, which will provide much more stringent tests of the origin of the reduced E2 collectivity in these nuclei. (*ii*) The Sn isotopes with the doubly-magic ^{132}Sn, where only very limited experimental data are available, is another excellent possibility to test model calculations for quadrupole and octupole collective states in doubly magic nuclei. (*iii*) Finally a more systematic study of the octupole collectivity along the chain of Xe isotones ends this unique series of investigations. Experimentally, the beam time estimates sound reasonable and an error of around 10% should be reachable for the measurement of B(E2) and B(E3), using an experimental setup combining EXOGAM (or AGATA) and PARIS, with a fair bit of large-area position-sensitive silicon detectors "on top".

LoI_SP2_Ph2 22: Study of collective modes of excitations in the neutron rich Ba region via fusion-evaporation reactions
A. Maj, S. Leoni *et al.*

This LoI addresses the unique features of SPIRAL2 for studies of nuclei under extreme angular momentum. The availability of radioactive neutron rich beams at energies around the Coulomb barrier will allow to perform symmetric fusion evaporation reactions which are more stable against fission, allowing to reach very elongated nuclear shapes at high spins.
In such conditions studies of collective modes at very high angular momentum, like the hyper-deformation or the Jacobi shape transition, are expected to be feasible. It is proposed to utilise the most intense Kr beam, ^{90}Kr ($T_{1/2}$=32.3 s), to bombard a ^{48}Ca target to produce the compound nucleus ^{138}Ba with a spin around 90 ħ. In a second stage, it is also planned to use the more neutron-rich ^{94}Kr ($T_{1/2}$=0.20 s) beam to reach ^{142}Ba. The experiment will utilise AGATA, EXOGAM, and PARIS together with a tagging device (ex. the RFD). The SAC finds the aim of the LoI very interesting and challenging. Concerning the tagging device some concerns exist on the use of the RFD in view of the limited beam intensity. The SAC encourages the proponents to investigate possible solutions to this problem (the tagging device) which is common to all the LoIs based on fusion-evaporation reactions.

LoI_SP2_Ph2 23: Search for hyper-deformation at very high spin in Cd and Pd isotopes with fusion-evaporation reaction using ^{92}Kr beam
A. Korichi *et al.*

A possible third minimum in the nuclear potential surface at very high spins with axis ratio 1:3, the so-called hyper-deformation has been searched for by the high-spin community for years, and is a major goal in their nuclear-structure research efforts. These efforts have, however, been without success for different reasons like difficulties in the experiments in which the experimental detection systems were not optimal. The SPIRAL2 Facility might put an end to this struggle and finally offer the environment where this experimental challenge might be fulfilled. Supported by theoretical calculations, the region of the nuclear chart to look for this exotic shape is in the Cd and Pd regions. The LoI suggests two interesting cases namely ^{110}Pd and ^{112}Cd produced by the fusion-evaporation reaction ^{92}Kr+^{26}Mg at about 6 MeV/u. The isotope ^{92}Kr has a half-life of 1.29 s and the experiment is thus a typical RIB opportunity to solve a problem which for years could not be successfully addressed by the physics community. SPIRAL2 together with AGATA and/or EXOGAM coupled to particle identification systems seem to be a very possible scenario for a success here. The SAC appreciates the challenge and the discovery of hyper-deformation would be a great achievement but, in view of the limited beam intensity, the SAC encourages the proponents to examine seriously the background contribution. This issue, common to all the LoIs based on fusion-evaporation reactions, can be examined joining efforts of the different collaborations. This experiment cannot be considered at the moment a day-one experiment
In particular, it should be noted that the proposed experiment is almost identical to that of LoI-25. Some coordination is desirable.

LoI_SP2_Ph2 24: Structure of Sb nuclei around ^{132}Sn as a testing ground for realistic shell model interactions
B. Fornal, S. Lunardi, G. de France *et al*.

The LoI proposes to study the structure of nuclei around ^{132}Sn as a test for shell model interactions. Spectroscopic information will be used to extract empirical diagonal two-body matrix elements allowing the test of realistic interactions in that mass region. The nuclei of interest will be populated through incomplete fusion reactions and selected by detecting the emitted alpha particles. For gamma-ray and charged-particle detection, the proponents propose to use existing (or almost existing) instrumentation (EXOGAM or AGATA and DIAMANT or GASPARD).
The SAC finds the physics case of the LoI convincing and the technique very well chosen. The use of existing instrumentation qualifies this LoI as a `day-one experiment`. Therefore, the SAC strongly encourages the collaboration to develop their ideas towards a more specific proposal.

LoI_SP2_Ph2 25: Investigation of extreme deformation in Cd isotopes at high angular momentum
A. Görgen *et al.*

The proposed experiment is an attempt to populate hyper-deformed states in ^{112}Cd expected on the basis of a Jacobi transition occurring at high angular momenta. The proposal argues that high-intensity ^{92}Kr beams from SPIRAL2 together with high-efficiency γ-ray detection with AGATA- and EXOGAM-elements may enable measurements with a similar sensitivity to the case with stable beams. More realistic estimates on the overall efficiency should be made to show the feasibility of the proposed experiment. The motivation to find hyper-deformation is of interest though the physics of high angular momentum states was extensively investigated. Although the Jacobi transition has been predicted to occur based on the analogy with rotating gravitational masses, it is not clear whether or not it can occur in nuclei where the forces are short-range, in contrast to gravitation (long-range). Because this proposal is not based on firm grounds both from the experimental and theoretical points of view, it is not suited for a day-one experiment.
It should be noted that the proposed experiment is almost identical with LoI-23. Some coordination is desirable.

LoI_SP2_Ph2 26: Study of neutron-rich nuclei beyond N=50 using deep inelastic reactions
G. Duchêne, A. Gadea, D. Verney *et al*.

The dependence of neutron single-particle energies on proton number (and vice versa) is a problem of current interest, especially in connection with the existence (or lack of) a tensor component in the effective nucleon-nucleon interaction. The proposed experiment is to access the neutron-rich nuclei beyond N=50, by using deep-inelastic reactions that will reach N=51 in 2011 at LNL. Simple extension of the method to unstable projectiles becomes possible by intense ^{92}Kr beams (2.6×10^{8} pps) from SPIRAL2 and high-efficiency devices, AGATA and VAMOS, together with the proposed long run. However, it is not clear what the proponents can contribute to this study in addition to the study planned at LNL in 2011. Perhaps, this LoI should be re-submitted after the completion of the experiment at LNL, focusing on what nuclei the proponents

precisely intend to reach at SPIRAL2. Technical issues, regarding setting VAMOS at the grazing angle (68°) for example, should be further considered in the meantime.

LoI_SP2_Ph2 27: Spectroscopy studies around ^{78}Ni and beyond N=50 via transfer and Coulomb excitation reactions
G. de France, A. Gadea, J. J. Valiente-Dobon, R. Orlandi *et al.*

A major goal of present-day experimental nuclear structure is to measure properties of nuclei far from stability. The region of neutron-rich nuclei around ^{78}Ni is of interest in understanding whether or not the neutron shell closure at N=50 persists in neutron-deficient nuclei. The proponents argue that this region is difficult to reach with stable beams. It is therefore well suited for study at SPIRAL2. The physics motivation is well written, and encompasses both single-particle and collective aspects. The proponents suggest four experiments, two Coulomb excitation and two transfer reactions. For a day-one experiment, it may be good to concentrate on just one experiment. The (*d*,*p*) transfer reaction using beams of ^{81}Ga and ^{79}Zn isotopes appears to be the most interesting among those proposed.

LoI_SP2_Ph2 28: Missing links in the series of the superdeformed lead nuclei along isospin content
N. Redon *et al.*

The goal of the experiment is population, identification and study of the super-deformed band(s) in $^{199, 200}$Pb, *i.e.* for lead isotopes heavier than those previously accessible via fusion-evaporation reactions with stable-isotope beams. This will, in principle, be possible with the intense, neutron-rich, medium-mass radioactive beams of fission fragments that will be available at SPIRAL2. With the expected intensities of such beams, incident on neutron-rich light-mass target nuclei (such as in the proposed reaction (^{140}Xe+^{64}Ni)), fusion evaporation residues of sufficient intensity are expected. However, the actual beam intensities required by the proposal (*i.e.* up to 5×10^8/s) are challenging, yet still nearly 2 orders of magnitude below the typical beam intensities used in previous super-deformation studies with stable beams, such as those producing ^{198}Pb.
Clearly, the study of the super-deformed band with its small yields at high spin, compared to the ground-state bands etc., is quite a challenge. On the other hand, the inverse reaction with neutron-rich beam on neutron-rich light stable-isotope targets (*e.g.*, ^{48}Ca or ^{64}Ni) have long been proposed as a unique way to extend high-spin studies to more neutron-rich nuclei. And the scientific motivation for the specific system proposed here is very strong. Theoretical predictions, while reproducing the characteristics of super-deformed bands in ^{194,196}Pb have failed in ^{198}Pb. Several aspects, from the importance of simultaneously present high-*j* proton and neutron orbitals and residual neutron-proton interaction, to the competition between Coriolis force (anti-pairing) and pairing correlations at large deformations come into play. Clearly, the evolution of collective structure in lead nuclei, ultimately approaching doubly-magic ^{208}Pb, is of considerable interest and perhaps a text-book case for tests of current (mean-field) nuclear models.
The experimental setup has not yet been fully defined and needs to be worked out. This concerns not so much the γ-ray detection part, where the AGATA/EXOGAM2 coupled to the NEDA neutron detector will be a powerful setup, but rather the spectrometer for tagging the evaporation residues. This needs to be worked out in detail in the proposal, including full-fledged simulations,

and not forgetting the background issues that will arise from the ^{140}Xe (and subsequent chain of daughter) beta decays.

LoI_SP2_Ph2 29: Proton-neutron interactions and the onset of collectivity beyond ^{132}Sn from *g*-factor measurements
A. Stuchbery, G. Georgiev *et al.*

This LoI aims at the study of neutron-proton interactions for nuclei beyond doubly-magic ^{132}Sn and at the onset of collectivity, by a combined measurement of *g*-factors and B(E2)s for 2^+ states in isotopes with 2 or 4 neutrons, and/or 2 or 4 protons added to ^{132}Sn. The setup, a large Ge-array such as a combination of EXOGAM2 and AGATA and/or single-crystal EUROBALL detectors in coincidence with a segmented silicon particle detector, allows for a simultaneous transient field and recoil in vacuum measurement with a magnetised iron target. The iron target is used for both, for Coulex and as the ferromagnetic medium for the transient field measurement, optimising the simultaneous measurement of B(E2)s and *g*-factors. The SAC considers the set-up very suitable for these studies.
The onset of collectivity beyond ^{132}Sn and the transition to the strongly deformed region of heavier nuclei is clearly a significant feature for understanding the corresponding mean-field properties and underlying microscopic nature of its parameters; in particular, also in view of the stability of the structure of tin nuclei between mass 100 and 132. On the other hand, theory makes widely varying predictions for the states in question depending on their nature as neutron or proton excitations. The SAC considers the information to be gained in these experiments as important and supports the submission of a full proposal. Primary focus on ^{136}Te as day-one experiment is strongly supported.

LoI_SP2_Ph2 30: Determining the α + ^{15}O radiative capture rate by measurement of the ^{6}Li(^{15}O,*d*)^{19}Ne reaction
Ch. A. A. Diget, B. R. Fulton *et al.*

The proposed experiment is aimed at extracting the α-decay width of the 4.033 MeV state in ^{19}Ne by measuring the α-transfer cross section with the ^{6}Li(^{15}O,*d*)^{19}Ne reaction. This width determines the astrophysical reaction rate for the ^{15}O(α,γ)^{19}Ne reaction, a key reaction for the breakout from the hot CNO cycle for hydrogen burning.
The physics goal and motivation of this proposal are clearly spelled out. The experiment is an important contribution to nuclear astrophysics. The reason why this experiment needs to be carried out at SPIRAL2, the high intensity of the ^{15}O beam, is also clearly stated and the experiment is well designed. A weak point, namely applying the α-transfer reaction to extract the α width, is overcome by comparison with the mirror reaction ^{15}N(^{6}Li,*d*)^{19}F where the α width is known. The feasibility of the measurement depends on the ^{15}O beam intensity.

LoI_SP2_Ph2 31: Transfer to bound and unbound states and its influence on reaction dynamics near Coulomb barrier
A. Shrivastava, A. Chatterjee *et al.*

The SAC believes an understanding of reaction dynamics is important for a variety of reasons. How reaction cross-sections are affected by the structures of nuclei and by low-lying resonances

in the continuum is an important topic in its own right and is also important if we are to exploit the beams for other purposes. This LoI clearly recognises that it is important to determine what happens in all of the channels which are open. If the collaboration has not already done so, they should ensure that they have enlisted suitable theoretical support. They should not simply rely on using coupled-channel codes such as FRESCO.
Even within the coupled-channel theory and known nuclear-structure information, the collaboration should investigate whether there are differences among the quoted reaction systems, $^{14}O+^{208}Pb$, $^{14}C+^{208}Pb$ and $^{16}O+^{208}Pb$, to show the significance of the proposed experiment. The SAC is not sure if the differences are manifested, since these nuclei are rather well bound and the particle degree of freedom does not contribute much to the reaction dynamics.

LoI_SP2_Ph2 32: Shape coexistence in neutron-rich Sr and Kr isotopes around *N*=60
E. Clement, L. Nalpas, N. Warr, G. Georgiev, G. Simpson *et al.*

The LoI proposes to study shape coexistence and the onset for deformation around *N*=60 using EXOGAM/AGATA in connection with GASPARD and VAMOS. The collaboration proposes a large and interesting physics case including Coulex, few-nucleon transfer and multi-nucleon transfer reactions.
This is of broad interest because various data exist from decay spectroscopy of fission products that suggest transition from single-particle to collective excitations, shape co-existence, and oblate to prolate transitions in this mass region. This in turn provides a stringent testing ground for nuclear mean-field theory including, perhaps, concepts of quantum phase transitions in finite systems. The availability of a broad range of intense beams of fission products at SPIRAL2 invites the systematic study proposed here. This also suggests that the proponents should attempt to coordinate with other proposals that aim for similar systematic studies in other mass regions (such as around ^{132}Sn) with essentially similar approaches and techniques, *i.e*. inelastic scattering and nucleon transfers.
For day-one experiments, the SAC recommends concentrating on the Coulex experiments which need lower intensities and lower energies and are feasible from the beginning of the radioactive beam operation at SPIRAL2. The SAC encourages the collaboration to investigate the problems in connection with the other parts, *i.e*. the less favourable charge state needed for the transfer reactions and the necessity to move VAMOS to an angle beyond the maximum angle possible.

LoI_SP2_Ph2 33: Neutron shell evolution in weakly-bound neutron-rich $^{134,135}Sn$ beams via (*d*,*p*) reactions
V. Lapoux, O. Sorlin *et al.*

The main goal of this proposal is to study the evolution of the shell gaps for weakly-bound, neutron-rich nuclei. This very ambitious programme will be carried out through direct reactions in inverse kinematics on proton and deuteron targets such as (*p*,*d*), (*p*,*t*), and (*d*,*p*) over extended isotopic chains, reaching out towards the neutron drip line as the most neutron-rich beams are delivered by the facility.
The first goal of the proposal is to investigate the shell effects of the Sn isotopes around N=84,85 via the one-neutron (*d*,*p*) transfer reaction using $^{134,135}Sn$ beams. The proposal is very broad. It also aims to do similar experiments in the region around N=60 using the neutron-rich $^{96\text{-}97}Kr$ beams.

Even though the physics case is relevant to the SPIRAL2 physics and of high scientific interest, the SAC suggests to the proponents that they should focus their initial efforts on one dedicated region and to submit, in due time, a proposal to the SPIRAL2 PAC.

LoI_SP2_Ph2 34: How Magic is ^{78}Ni?
W. Catford, O. Sorlin *et al.*

The question posed in the title of this proposal, namely "How magic is ^{78}Ni ?" is part of one of the central themes to emerge from the discussion and preparations for SPIRAL2. There is no doubt that it will be a significant element in the scientific programme of SPIRAL2. The equipment involved in the LoI, namely EXOGAM/GASPARD or TIARA-MUST/VAMOS has been developed for this purpose amongst others. Transfer reactions and shell quenching and shell mobility will be important at SPIRAL2. At least three different setups are being proposed for use in such experiments, each with its own strengths and weaknesses. The equipment is at various stages of development and funding. It might be advantageous at this point to bring all of the interested parties together to discuss the strengths and weaknesses of each approach.

LoI_SP2_Ph2 35: Two-proton capture on ^{15}O and protons correlation in two-proton emission from excited states of ^{17}Ne
M. Assié, F. de Oliveira Santos *et al.*

There is undoubtedly considerable interest in nuclear reactions which are thought to be involved in novae and X-ray bursts. Two-proton capture is certainly important at certain points on the breakout from the hot CNO cycle and the *rp*-process. Here, the thesis is that a process akin to the "Hoyle" process involved in the formation of ^{12}C, leads to two-proton capture on ^{15}O leading to ^{17}Ne. This would have been more convincing if an estimate had been made of the density of 2H (^{2}He) resonant states in typical stellar conditions to allow an estimate of the production of ^{17}Ne by this route. The decay of states of ^{17}Ne is also of interest. The collaboration should develop these ideas further.

LoI_SP2_Ph2 36: Study of pair transfer in the ^{134}Sn nucleus via ^{132}Sn(t,p) ^{134}Sn reaction
O. Sorlin, K. Wimmer *et al.*

This proposal aims at measuring the neutron-pair transfer in (t,p) reactions for nuclei beyond ^{132}Sn. The goal is to study pair transfer to nuclei with reduced neutron binding and to learn to what extent pair transfer (and pairing) is influenced by nuclear diffuseness and the nearby continuum. This is of principle interest, but also because one hopes (together with the information from the single-neutron transfer measurements proposed in the subsequent LoI) to obtain insight into the single-particle and collective structure of nuclei beyond doubly-magic ^{132}Sn.
As day-one experiment the authors propose the ^{132}Sn(t,p)^{134}Sn reaction. The SAC considers this a prudent choice, not only because it promises the highest beam intensity but also, as the proposal points out, already in ^{133}Sn the $p_{1/2}$ single-particle state is only bound by 1 MeV. The neutron binding beyond ^{132}Sn indeed drops quickly, a well-known fact. But in particular certain excited single-particle states move quickly near to, or into the continuum. In addition, because of the attractive interaction between $f_{7/2}$ neutrons and the repulsive interaction between $f_{7/2}$ and $p_{3/2}$ neutrons, a neutron gap is expected for N=90, ^{140}Sn.

The experimental setup is proposed to be GASPARD plus, possibly, a γ-ray detector such as PARIS to help disentangle unresolved states in the particle spectrum. The major experimental challenge is the tritium target, but the authors show convincingly that based on past experience at several facilities, a tritium loaded titanium target can provide an adequate target thickness and be stable under the beam intensities expected for the radioactive beams envisaged. Altogether the experimental approach is carefully discussed, in principle, and considered adequate by the SAC. The SAC expects that for the proposal the detailed setup is presented, with simulations for the expected results.
The general science case is reasonably worked out and the SAC supports such studies strongly. However, the SAC would like to point to the fact, of which the proponents are aware, that neutron-pair transfer to levels in ^{134}Sn does not proceed through pure configurations of $(3p_{1/2})^2$ or $(3p_{1/2})^2$ but may also involve pair transfer into the *f* orbit. In general, neutron-pair transfer to any level in ^{134}Sn will involve a coherent mixture of several configurations. It is indeed important to have a good theoretical estimate of the configurations involved in each of the low-lying 0^+ states in ^{134}Sn and use these in estimating the cross sections. Furthermore, the reaction mechanism at a bombarding energy of 8 MeV/u could be even more complicated than only direct and sequential transfer. The energy is low enough that fusion and statistical decay may have a significant contribution to the cross section. In the follow up of this proposal, the SAC would appreciate to see these issues addressed.

LoI_SP2_Ph2 37: Explosive hydrogen burning studies through the one-proton (^{3}He,*d*) transfer reaction: case of the ^{25}Al(*p*, γ)^{26}Si, ^{60}Zn(*p*, γ)^{61}Ga and ^{102}In(*p*, γ)^{103}Sn reactions
N. de Séréville, F. Hammache *et al*.

There are a few key reactions that play important roles in explosive hydrogen-burning environments such as in novae and in X-ray bursts. The proponents of this LoI propose to study the ^{25}Al(*p*, γ)^{26}Si reaction which is crucial for understanding nucleosynthesis of ^{26}Al in novae and is of relevance for γ-ray astronomy. In this case, the proton widths of three known resonances that occur just above the proton separation energy in ^{26}Al are not known and need to be determined in order to calculate the reaction rate at stellar temperatures. The proponents also propose to study the reactions ^{60}Zn(*p*,γ)^{61}Ga and ^{102}In(*p*,γ)^{103}Sn, which are key reactions in the *rp*-process driving X-ray bursts. In this case, it is also aimed to determine the masses of ^{61}Ga and ^{103}Sn with a better precision as these suffer now from large uncertainties. The proposed experimental procedure in both cases is to use the (^{3}He,*d*) reaction in inverse kinematics, wherein the reactions will be tagged by detecting the recoil nuclei in the VAMOS spectrometer. The deuterons will be measured with GASPARD in the case of ^{26}Al. This will be done in coincidence with γ rays from resonance decay detected with PARIS to reduce background. In the case of ^{61}Ga and ^{103}Sn, the deuterons will be detected with ACTAR allowing for a mass determination with uncertainty of about 25 keV. This LoI deals with a very interesting topic of much current interest. The experimental procedure proposed is robust and will allow for a day-one experiment if the detectors GASPARD, PARIS and ACTAR are ready in time. However, considering that the setup for measuring masses with very high precision with Penning traps will be available on time, the proponents are encouraged to seek collaboration to measure the masses of ^{61}Ga and ^{103}Sn with the MLLTRAP Penning trap mass spectrometer.

LoI_SP2_Ph2 38: Investigation of the microscopic structure of Pygmy Dipole Resonances using transfer reactions
D. Beaumel, A. Maj *et al.*

This LoI proposes to obtain information on the microscopic structure of the Pygmy Dipole Resonance (PDR) recently observed in ^{132}Sn in a (relativistic energy) Coulomb excitation experiment. The PDR is generally (macroscopically) pictured as a soft vibrational mode of an extended neutron surface (neutron skin and in the extreme a neutron halo) against the compact nuclear core. Whether there is any justification for such a picture requires more detailed studies of, preferably, microscopic information for the state(s) involved. The SAC considers such effort in general as interesting.
The present LoI proposes to obtain such information by single-neutron transfer from ^{131}Sn to ^{132}Sn, *i.e*. transfers to the excitation energy region of the PDR around 10 MeV, well into the continuum (S_n= 7.3MeV). To isolate the PDR from the (many) other continuum states presumably populated in the reaction, it is proposed to detect gamma-rays to the ground state and to the first-excited 2^+ state in ^{132}Sn, the rationale being that only E1 gamma transitions have enough width to lead to a measurable gamma-decay rate. This raised some concerns in the SAC since the single-particle transfer could lead to one or two of the many configurations of the PDR wave function. It is also more likely to populate many different states, e.g., high angular momentum states for momentum matching reasons, which would overlap with the PDR states and thus would provide a large background; or the population of other low-spin states having little to do with the PDR but nevertheless decaying by E1 radiation to the 2^+ state. Furthermore, the branching ratio for γ decay compared to neutron decay would be 10^{-3} or smaller. Therefore, to detect the PDR branch with a γ-ray yield of about 10 events per UT, as estimated in the proposal and which even seems quite optimistic, looks extremely challenging in general.
The setup proposed is GASPARD for the proton detection and PARIS for the gamma rays. This seems in itself appropriate. It is also argued that because the resolution is determined by the γ-ray detection, very thick targets will not limit it and thus could be effectively used to increase the reaction rate. This is probably also true.
Overall though, while the SAC finds the concept of the proposal somewhat interesting, it is not convinced that there will be the actual sensitivity to the PDR branch; it is also concerned whether the specific experimental conditions will provide the information aimed for. It feels that a credible simulation and quantitative rate estimates are necessary, based on the actual experimental setup, some approximate transfer yields to high excitation energies (and the continuum) from experiments on stable nuclei, and in particular some theoretical guidance as to the expected PDR cross sections/yields and decay branching ratios. Such estimates could be presented at a future SAC meeting.

LoI_SP2_Ph2 39: Exploration of cluster break-up in light exotic nuclei
J. A. Scarpaci, M. Assié *et al.*

The study of cluster properties of light nuclei is still of considerable interest, especially in view of the development of novel theoretical techniques to study it. This LoI proposes to study the structure of ^{14,15,16}O produced at SPIRAL2, in order to understand how clustering depends on neutron number. Although of some interest, it is not clear whether or not this interest is sufficiently high to warrant a day-one experiment. Perhaps the proponents should resubmit this

proposal at a later stage, accompanied by an estimate of the "expected behaviour". Cluster studies of ^{16}O are well known and calculations for the O isotopes within the Molecular Orbital Method can be done. If this is to be a day-one experiment it needs more substance and focus.

LoI_SP2_Ph2 40: The role of isospin in the formation and decay of excited nuclei
G. Casini, N. Le Neindre *et al.*

This proposal aims at studying the influence of isospin in the formation and decay of excited states of nuclei formed in heavy-ion reactions at energies slightly above the Coulomb barrier and for N/Z ratios that vary between about 1.1 and 1.6. Beams of krypton isotopes from SPIRAL2, namely ^{80}Kr and ^{94}Kr, at around 10 A·MeV or slightly below will be used. At these energies, mean-field effects are dominant and heavier nuclei are formed by fusion and/or deep-inelastic collisions (DIC). Evolution of the formed system and its N/Z equilibration are still poorly understood. Investigation of isospin-sensitive observables in fusion (+fission) and DIC is very important and is connected to the equation of state of nuclear matter through the link of isospin drift and diffusion to density dependence of the symmetry energy in asymmetric nuclear matter. The proponents intend to use a whole arsenal of detection equipment such as the technically very advanced detector array FAZIA with excellent mass and charge identification capabilities together with low detection thresholds. This will be coupled with INDRA to extend the detection efficiency, with VAMOS to allow tagging with identified evaporation residues and possibly with neutron detectors to characterise the reactions as fully as possible.
The physics addressed with this LoI is quite interesting. It requires strong support from theory and the collaboration has managed to successfully engage theoretical groups in this research programme. It is important that the theory support is given at an early stage to help the collaboration identify the most important observables to look for experimentally. With the help of this theoretical support it would be useful if the collaboration performs simulations showing what detection scenarios of interesting physics one can expect with the different detector combinations proposed.

LoI_SP2_Ph2 41: Transport properties of isospin asymmetric nuclear matter
R. Lemmon *et al.*

This LoI proposes to study the transport properties of isospin asymmetric nuclear matter at near saturation density by investigating charge equilibration in deep-inelastic collisions with beams of ^{78}Kr and ^{92}Kr on a ^{238}U target. The aim is to compare the experimental observables to transport-model calculations and extract drift and diffusion coefficients. The collaboration benefits here from a strong involvement of theoretical groups.
The SAC acknowledges the interesting physics case made with FAZIA at rather low energies. The collaboration should, with the aid of model calculations, define the interesting experimental observables and sharpen thus the physics case. The collaboration should also take into account that moving VAMOS to 66^{o} might not be possible. This issue should be addressed before re-submission of the proposal.

LoI_SP2_Ph2 42: Evolution of nuclear shell structure in the vicinity of ^{78}Ni and ^{132}Sn with ACTAR
G.F. Grinyer, E. C. Pollacco *et al.*

This letter of intent proposes the study of the single-particle structure in key regions of the nuclear chart, around ^{78}Ni and ^{132}Sn. The combination of the intense SPIRAL2 beams together with the very high-efficiency active target should enable studies much farther from stability than it is possible now. The resolution should be sufficient to resolve most of the levels. This is quite clearly a day-one experiment. In its most simple configuration, it should be a more or less straightforward experiment. The coupling of ACTAR to other detectors, such as EXOGAM2, AGATA, or PARIS is considered in the LoI. This may increase the quantity and quality of the experimental information that could be collected. The SAC encourages the collaboration to submit a proposal that will specify the priorities with respect to the beams, and with respect to the general layout of the experiment. Some model calculations for the selected beam(s) should be presented to show the dependence of cross sections and angular distributions on the angular momentum transfer.

LoI_SP2_Ph2 43 Measurement of proton-capture reactions in the *rp*-process nuclei ^{60}Zn and ^{64}Ge with ACTAR
M. Caamaño *et al.*

This LOI proposes to study the proton capture on the astrophysically important nuclei ^{60}Zn and ^{64}Ge. The proton-capture reaction on these nuclei is an important step for the *rp* process to proceed to heavier masses.
The SAC feels that the physics case is well defined and the scientific importance is well underlined. The collaboration should determine, by means of simulations, down to which limit the capture reaction can be identified due to the range/energy loss difference of the projectile and the capture product. These simulations should include detector-resolution and straggling effects. A coincidence with a simple but efficient γ-detector could eventually greatly improve the rejection of beam events without reaction. The collaboration should also consider whether the low-intensity beams available for the isotopes of interest are ideal for a day-one experiment or whether a day-one experiment should be performed with another, maybe less interesting, nucleus.

LoI_SP2_Ph2 44 Disappearance of the $N = 20$ shell closure far from stability: investigation of ^{27}Ne with resonant scattering in ACTAR
A. Gillibert, R. Raabe *et al.*

This LoI aims at mapping the appearance of intruder states across the Ne isotopic chain in order to gain further insight into changes in the shell structure for nuclei far from stability. Supported by theoretical calculations, it is proposed to investigate states in ^{27}Ne, through the population of their isobaric analogues in ^{27}Na, produced by ^{26}Ne+p resonant reactions. The use of the active target ACTAR, surrounded by ancillary solid-state charged-particle detectors, would allow to reconstruct the full kinematics through the energy of the proton and the range of the heavy nucleus leading to the measurement of the excitation function at different angles; assignment of spin-parity would be possible via the measurement of the widths of the populated isobaric analogue states (IAS) resonances and the angular distributions of the emitted particles.

The SAC recognises the interest of the study of neutron-rich nuclei by the observation of the IAS, and ACTAR with ancillary detectors is certainly very well suited for such studies. However, the ^{26}Ne beam, even at 10^4 pps, is not scheduled at SPIRAL2 while it is produced at SPIRAL1 with a beam intensity of 10^3 pps. Therefore, this proposal cannot be considered as a day-one experiment for SPIRAL2, and the proponents are encouraged to examine other systems accessible with the beams available with sufficient intensities.

LoI_SP2_Ph2 45 Gamma transition probability in unbound nuclei
I. Stefan, F. de Oliveira Santos *et al.*

The LoI proposes to study the second-excited state of ^{15}F by selectively populating this state with a ^{14}O beam on a thin CH_2 target. This state is highly unbound and should decay mainly by proton emission to the ground state in ^{14}O. Two more decay channels are open and may thus contribute to the decay, one by two-proton emission and the other by γ emission. However, the fact that this state is rather narrow indicates most likely that its structure is of the ^{13}N+2*p* type rather than of the ^{14}O+*p* type. The main aim of the LoI is to observe the γ decay of this second-excited state to the broad ground state of ^{15}F which then decays to the ^{14}O ground state, providing a good example of dipole transitions between unbound states.
The SAC thinks that this is a nice physics case and, even if the γ decay is not observed, one can study the configuration of this second-excited state via the one- and two-proton emission branching ratios. The SAC strongly encourages the collaboration to consider the possibility to add a high-efficiency γ array like PARIS in order to search for proton-gamma coincidences which should significantly increase the sensitivity of the experiment.

LoI_SP2_Ph2 46 The (α,*p*)-process in X-ray bursts: study of ^{30}S(α,*p*)^{33}Cl reaction rate with SPIRAL2 radioactive beam
F. Hammache, N. de Séréville *et al.*

The LOI proposes to study the (α,*p*) reaction with a radioactive beam of ^{30}S. The luminosity curve of X-ray bursts is very sensitive to this capture reaction that seems to be at the origin of the kink in the light profile.
The SAC acknowledges the very nice physics case and the clear objectives of the experiment. In particular, the fact that the collaboration will first measure the resonances in ^{34}Ar via the ^{33}Ar(*d*,*p*)^{34}Ar reaction, as discussed during the presentation, is appreciated by the SAC and is considered to be important for the success of the (α,*p*) experiment. In view of the expected low counting rates, the SAC encourages the collaboration to consider possible tests with higher intensity beams, like ^{34}Ar for example. In addition, the SAC would like to have more information about the high-density helium gas-jet target.

LoI_SP2_Ph2 47 Study of ^{19}Ne states near the ^{18}F+*p* threshold (^{15}O+α resonant elastic)
T. Davinson, F. de Oliveira Santos *et al.*

The proposed experiment of ^{15}O+α resonant scattering could be an important step towards the complete understanding of the ^{18}F(*p*,α)^{15}O reaction, which is of astrophysical interest. The high-intensity ^{15}O beam from SPIRAL2 is expected to considerably improve the experimental condition compared with the ones in the previous attempts at SPIRAL1 and Louvain la Neuve

with lower ^{18}F intensities. A concern is if the resonance signals are large enough for extracting information in the Coulomb-dominant scattering. Simulation calculations with the R-matrix theory could show the feasibility of the measurement more convincingly.

LoI_SP2_Ph2 48 Study of ^{19}Ne states near the ^{18}F+*p* threshold (^{18}Ne(*d*,*p*)^{19}Ne* reaction)
T. Davinson, F. de Oliveira Santos *et al.*

The proposed experiment is aimed at improving the accuracy in the α branching ratio of the 4.033 MeV state in ^{19}Ne with the high ^{18}Ne beam intensity expected at SPIRAL2. Coupled with the available radiative width (almost equal to the total width), the astrophysical reaction rate for the ^{15}O(α,γ)^{19}Ne reaction is obtained. This reaction has attracted much attention, since it is a key reaction for the breakout from the hot CNO cycle for hydrogen burning. The expected 40 events in a 10-day measurement far exceed the previous measurement with the same reaction, ^{18}Ne(*d*,*p*), which populate the state, and should lead to a branching ratio with higher accuracy compared with the result from the ^{19}F(^{3}He,*t*)^{19}Ne reaction. Since the evaluated count rate is marginal for the goal, efforts to increase the coincidence efficiency (5% in the LoI) by, for example, developing a detector system are desirable.

LoI_SP2_Ph2 49 The study of single-particle structure near doubly-magic ^{132}Sn
B. Kay *et al.*

The study of proton single-particle orbits in regions of double shell closure such as ^{132}Sn is complementary to neutron single-particle structure studies. The region of ^{132}Sn is clearly of great interest, and experimentally promising with the high intensities expected for SPIRAL2. Here, the reaction (^{4}He,*t*) or (^{3}He,*d*) is considered in this LoI. This reaction should be well suited for high angular momentum transfer. The experiment will need a gas target to be developed. The expected resolution of HELIOS for the reactions and the gas target to be developed should be illustrated, together with expected count rates for the thickness of the final target design. A plan should be developed for the financing of HELIOS@GANIL.

LoI_SP2_Ph2 50 Probing the pairing interaction through two-neutron transfer reactions
D. Beaumel *et al.*

This LoI proposes to probe the pairing interaction through the study of two-neutron transfer reactions on neutron-rich nuclei especially in the tin region. The SAC agrees that the question of pairing interactions is very challenging and relevant to the physics of SPIRAL2. Nevertheless, the SAC was not really convinced by the method proposed to probe the nature of the interaction (surface or mixed interaction) and that the observables were well adapted to the goal of the proposal.
The SAC welcomes the proposal and suggests that the proponents should interact more closely with theoreticians to find the relevant observables and to carry out simulations to prove the feasibility of such experiments.

LoI_SP2_Ph2 51 Spectroscopy studies toward ^{140}Sn using Coulex and transfer reactions of RIBs
R. Lozeva, K. Sieja *et al*.

This LoI proposes, as several others do, the study of Sn isotopes between ^{132}Sn and ^{140}Sn to explore the evolution of nuclear structure when moving towards extremes in N/Z. Specifically, the emphasis is on the evolution of the single-particle neutron states in the 3*p*2*f* shell, the effective interaction in this mass region, and the degree of collectivity away from the N=82 (^{132}Sn) and N=90 (^{140}Sn) (closed) neutron shells. With regard to the effective interaction, a particular goal discussed in this LoI is to investigate the potential influence of the three-body force on the magnitude of the spin-orbit shell gap, as the $2f_{7/2}$ neutron shell is gradually filling and closes at ^{140}Sn with 90 neutrons. A parallel is drawn to the current understanding of the interaction producing the large $1f_{7/2}$ neutron shell gap in ^{48}Ca. The SAC is sceptical that such a simple parallel can be drawn when going to substantially heavier nuclei. But this should not affect carrying out these important measurements.
The study is well motivated in its general physics goals but also in its measured experimental approach: Because of the initial limitations on beam intensity, the proposed day-one experiment focuses on the Coulomb excitation and the determination of the degree of collectivity for the $f_{7/2}$ to $p_{3/2}$ B(E2) transition probabilities in ^{135}Sn and ^{137}Sn. The authors claim that the expected cross sections (presumably also because of the expected relatively low energy of this transition in mid-shell) are sufficiently high under the proposed "safe Coulex" conditions (E < 5 MeV/u) to allow measurements of the B(E2) with the initial beam intensities of, *e.g.*, 5×10^2 for ^{137}Sn. For the Coulex setup the AGATA/EXOGAM2 arrays are proposed as gamma-ray detectors. An annular Si DSSD is placed behind the proposed Pd Coulex target to select coincident heavy reaction partners. The SAC finds the physics motivation and proposed execution for this specific part of the proposed programme compelling and supports it as a day-one experiment.
The authors then also mention single-particle transfer measurements on, *e.g.*, a deuteron target, with GASPARD replacing the Si DSSD as particle detector for the light charged-particle reaction products. This study has, of course, large overlap with several other LoIs proposing the same or very similar experiments. The SAC recommends that the different groups work together on a coherent programme and, if at all possible, on a largely common setup.

LoI_SP2_Ph2 52: Beta Decay and the $N = 82$ Waiting Point nuclei
B. Rubio, A. Algora *et al*.

This LoI is dedicated to the beta decay study on nuclei below ^{132}Sn. The aims are two-fold: these nuclei play a key role in the *r*-process particularly in the determination of the A=130 mass peak of the abundance distribution and since they are lying close to the doubly-magic ^{132}Sn, they are also important from the nuclear structure point of view.
The proposed measurements are done using the Total Absorption Spectrometer (TAS), combined with the BELEN neutron counter to determine neutron emission probability values P_n. The setup for this proposal is identical to the one proposed by J.-L. Taín *et al*. (LoI 20) with the same requirements, including the BESTIOL Penning Trap.
The SAC recognises the relevance of the experiment and encourages the proponents to carefully simulate the background to ensure its feasibility.

LoI_SP2_Ph2 53: Interference contributions to the astrophysical rate of the ^{14}O(α,p)^{17}F reaction
M. Aliotta, F. de Oliveira Santos *et al*.

There are many uncertainties in our knowledge of the nuclear reactions involved in breakout from the hot CNO cycle and the $^{14}O(\alpha,p)^{17}F$ reaction is one such case. An experiment is already scheduled at SPIRAL to study it, we understand. A more detailed study, focusing on interference effects, would certainly be justified and the SAC would expect to see such a proposal at SPIRAL2 in due course, based on the results of the experiment to be carried out soon.

5. *Topics, date and place of the next meeting*

The **next meeting** of the SPIRAL2-SAC will be a joint meeting with the GANIL Scientific Council. It will take place on **Thursday and Friday 29-30 September 2011** in Belgodère, Corsica and will be part of the **Colloque GANIL 2011** week, i.e. 25-30 September 2011.

The following topics will be discussed at the next SAC meeting:

- Evaluation of the status reports of the SPIRAL2 technical projects and detectors
- Final evaluation of the LoIs for SPIRAL2 Phase 1
- Merging of SPIRAL2-SAC and GANIL Scientific Council into one advisory board for GANIL.

6. *AOB*

The evaluation reports on the LoIs and the SAC minutes will be ready by the end of February 2011.

There being no other points on the agenda the meeting was closed at around 18:30.

Appendix 1
Agenda of the SPIRAL2 SAC meeting on January 26-28, 2011

Wednesday January 26th; Memorial, Caen
Open Meeting of SPIRAL2 SAC - 1: Theory & Detectors & LoIs SPIRAL2 Phase 2
Chair: M. N. Harakeh

14:30 - 15:10	Modern theoretical nuclear physics and the FUSTIPEN collaboration G. Bertsch, University of Washington, USA (30'+10')
15:10 - 15:30	S3 Status report - H. Savajols (15'+5')
15:30 - 15:50	NFS status report - X. Ledoux (15'+5')
15:50 - 16:10	HELIOS status report - B. Kay (15'+5')
16:10 - 16:25	LoI_SP2_Ph2 1 - P. G. Thirolf (10'+5')

16:25 – 16:45 Coffee Break

Open Meeting of SPIRAL2 SAC - 2: LoIs SPIRAL2 Phase 2
Chair: M. N. Harakeh

16:45 - 17:00	LoI_SP2_Ph2 2 - C. Weber (10'+5')
17:00 - 17:15	LoI_SP2_Ph2 3 - B. Blank (10'+5')
17:15 - 17:30	LoI_SP2_Ph2 4 - D. Lunney (10'+5')
17:30 - 17:45	LoI_SP2_Ph2 6 - F. Le Blanc (10'+5')
17:45 - 18:00	LoI_SP2_Ph2 7 - D. Verney (10'+5')
18:00 - 18:15	LoI_SP2_Ph2 8 - E. Liénard (10'+5')
18:15 - 18:30	LoI_SP2_Ph2 9 - T. Kurtukian-Nieto (10'+5')
18:30 - 18:45	LoI_SP2_Ph2 53 - M. Aliotta (10'+5')

19:30 *Conference dinner*

Thursday January 27th; Memorial, Caen
Open Meeting of SPIRAL2 SAC - 3: LoIs SPIRAL2 Phase 2
Chair: B. Blank

09:00 - 09:15	LoI_SP2_Ph2 25 - A. Görgen (10'+5')
09:15 - 09:30	LoI_SP2_Ph2 10 - D. Lunney (10'+5')
09:30 - 09:45	LoI_SP2_Ph2 11 - M. L. Bissell (10'+5')
09:45 - 10:00	LoI_SP2_Ph2 12 - D. T. Yordanov (10'+5')
10:00 - 10:15	LoI_SP2_Ph2 13 - J. Giovinazzo (10'+5')
10:15 - 10:30	LoI_SP2_Ph2 14 - T. E. Cocolios (10'+5')
10:30 - 10:45	LoI_SP2_Ph2 15 - F. Delaunay (10'+5')
10:45 - 11:00	LoI_SP2_Ph2 16 - P. Campbell (10'+5')
11:00 - 11:15	LoI_SP2_Ph2 17 - S. Grévy (10'+5')

11:15 – 11:30 *Coffee Break*

Open Meeting of SPIRAL2 SAC - 4: LoIs SPIRAL2 Phase 2
Chair: W. Gelletly

11:30 - 11:45 LoI_SP2_Ph2 19 - A. Algora (10'+5')
11:45 - 12:00 LoI_SP2_Ph2 20 - J. L. Tain (10'+5')
12:00 - 12:15 LoI_SP2_Ph2 52 - B. Rubio (10'+5')
12:15 - 12:30 LoI_SP2_Ph2 21 - W. Korten (10'+5')
12:30 - 12:45 LoI_SP2_Ph2 22 - A. Maj (10'+5')
12:45 - 13:00 LoI_SP2_Ph2 23 - A. Korichi (10'+5')
13:00 - 13:15 LoI_SP2_Ph2 24 - B. Fornal (10'+5')

13:15 – 14:30 Lunch

Open Meeting of SPIRAL2 SAC - 5: LoIs SPIRAL2 Phase 2
Chair: D. Guillemaud-Mueller

14:30 - 14:45 LoI_SP2_Ph2 26 - G. Duchêne (10'+5')
14:45 - 15:00 LoI_SP2_Ph2 27 - G. de France (10'+5')
15:00 - 15:15 LoI_SP2_Ph2 28 - N. Redon (10'+5')
15:15 - 15:30 LoI_SP2_Ph2 29 - A. Stuchbery (10'+5')
15:30 - 15:45 LoI_SP2_Ph2 30 - Ch. A. A. Diget (10'+5')
15:45 - 16:00 LoI_SP2_Ph2 31 - A. Shrivastava (10'+5')
16:00 - 16:15 LoI_SP2_Ph2 32 - E. Clement (10'+5')
16:15 - 16:30 LoI_SP2_Ph2 33 - V. Lapoux (10'+5')

16:30 – 17:00 Coffee Break

Open Meeting of SPIRAL2 SAC - 6: LoIs SPIRAL2 Phase 2
Chair: G. De Angelis

17:00 - 17:15 LoI_SP2_Ph2 34 - W. Catford (10'+5')
17:15 - 17:30 LoI_SP2_Ph2 35 - M. Assié (10'+5')
17:30 - 17:45 LoI_SP2_Ph2 36 - O. Sorlin (10'+5')
17:45 - 18:00 LoI_SP2_Ph2 37 - N. de Séréville (10'+5')
18:00 - 18:15 LoI_SP2_Ph2 38 - D. Beaumel (10'+5')
18:15 - 18:30 LoI_SP2_Ph2 39 - J. A. Scarpaci (10'+5')
18:30 - 18:45 LoI_SP2_Ph2 40 - G. Casini (10'+5')
18:45 - 19:00 LoI_SP2_Ph2 41 - R. Lemmon (10'+5')
19:00 - 19:15 LoI_SP2_Ph2 42 - G.F. Grinyer (10'+5')
19:15 - 19:30 LoI_SP2_Ph2 5 - P. Campbell (10'+5')

20:00 Dinner

Friday January 28th; Maison d'Hôtes, GANIL
Open Meeting of SPIRAL2 SAC - 7: LoIs SPIRAL2 Phase 2
Chair: N. Alamanos

09:00 - 09:15 LoI_SP2_Ph2 18 - Maria José G. Borge (Withdrawn)
09:15 - 09:30 LoI_SP2_Ph2 43 - M. Caamaño
09:30 - 09:45 LoI_SP2_Ph2 44 - A. Gillibert
09:45 - 10:00 LoI_SP2_Ph2 45 - I. Stefan
10:00 - 10:15 LoI_SP2_Ph2 46 - F. Hammache
10:15 - 10:30 LoI_SP2_Ph2 47 - T. Davinson
10:30 - 10:45 LoI_SP2_Ph2 48 - T. Davinson
10:45 - 11:00 LoI_SP2_Ph2 49 - B. Kay
11:00 - 11:15 LoI_SP2_Ph2 50 - D. Beaumel
11:15 - 11:30 LoI_SP2_Ph2 51 - R. Lozeva

Closed Meeting of SPIRAL2 SAC
Chair: M. N. Harakeh
11:30 - 19:00

1. Short Status report on SPIRAL2 and statistics LoIs
2. Evaluation of the S3, NFS and HELIOS status reports
3. Discussion of procedure of evaluation of LoIs

13:00 - 14:00 Lunch

4. Evaluation of the LoIs for day-one experiments with SPIRAL2 Phase 2
5. Topics, date and place of the next meeting
3. AOB

Appendix 2

Note on the status of the need for a spectrometer for the measurement of evaporation residues at GANIL/SPIRAL2

First call of LoIs SPIRAL2 2007

The discussion for the need of a spectrometer to tag evaporation residues produced in reactions using beams from SPIRAL2 was discussed with respect to the call for LoIs in 2007. This was specifically needed and would benefit the goals of LoIs 5, 7 and 9 dealing with fusion reactions, gamma spectroscopy and direct reactions for the astrophysical process. LoI 5 had proposed the idea of building a new spectrometer. The SAC at that stage recommended that the LISE Spectrometer in conjunction with the velocity filter was sufficient and suitable for this purpose and there was no need to build a new spectrometer.

GANIL2015

It was pointed out in the report from the cluster group for VAMOS that though it is a versatile device, it is not suitably adapted for zero-degree operation for evaporation residues with high intensity beams. Thus, the use of intense and heavy-ion beams for fusion reactions would require a separator at zero degree with a beam rejection factor better than 10^8. An "RMS-like" separator with improved acceptance was suggested. However, the core group of GANIL2015 did not identify it as a priority. The recommendations of the core group were "Detailed studies should be initiated that gives GANIL capability for zero-degree operation with intense SPIRAL2 beams. This includes improvements to the existing Wien filter of VAMOS and a study of the incorporation of a beam dump with a separate permanent beam-line; a study for upgrading the LISE beam line for zero-degree operation, that also allows use of large arrays around the target; changes of the focal-plane detector setup at SPEG which are required to perform reaction measurements with SPIRAL1 and SPIRAL2 beams.

These suggestions were looked into and the following conclusions were made:

1) Regarding the possibility of using the LISE Wien filter: a) This option is limited due to the relatively small angular acceptance and the lack of selection in mass. b) Presently the room D6 is incompatible with the large ancillary detectors like EXOGAM or AGATA thus restricting various physics possibilities. c) At this stage, it is not envisaged to transport high intensity beams ($I > 10^9$ pps) to the D6 area. An upgrade of D6 line to overcome these restrictions would involve the enlargement of D6*. The replacement of certain quadrupoles using the LISE2000 line and adding a bending magnet downstream the Wien filters could mimic the optics of the Daresbury recoil mass (M/Q) separator. The constraints are both, a large manpower and budget allocation and more cortically any modification will affect the ongoing physics programme at LISE.
2) The use of the VAMOS Wien filter was studied in the case of $^{22}Ne+^{238}U$ system and the rejection factor was not sufficiently high. Despite making it possible to operate VAMOS as a gas-filled separator (even though it has not be designed for such an operation) and a large suppression for direct kinematics, it is found not to be suitable for all reactions in symmetric and inverse kinematics of the type necessary with SPIRAL2.

Other options being discussed

a) A "low-cost fusion separator" could be implemented in the G2 experimental area, using the VAMOS Wien filter (after modifications), that could satisfy certain need of experiments for

gamma spectroscopy of the residues. However, such modifications of the VAMOS Wien filter could be suitable only for direct and symmetric kinematics (however, such an option would not be suitable for the inverse-kinematics reactions demanded in the present LoIs). b) The installation of the Krakow **R**ecoil **F**ilter **D**etector (earlier used with stable beams) is being looked into. A new/modified RFD for RIB is being investigated. c) Informal discussions on the use of the CAMEL RMS were suggested by a member of the SAC. This possibility needs to be discussed with LNL. The technical aspects and financial cost required for this need to be studied. The use of the G3 beam hall for this and the upgrade for SPIRAL2 beams also need then to be investigated*.

Conclusion: Though highly desirable, a new zero-degree spectrometer would represent an important investment (budget and manpower, not available today) and would require a strong support of external laboratories in building and financing this option. Numerous preliminary discussions have led to the different possibilities, which have to be evaluated in detail also taking into account radioprotection issues in order to take a final decision.

**Note on GANIL High Intensity Radioactive Ion Beams working group (HIRIB)*

To study the utilisation of high intensity beams at GANIL, a High Intensity Radioactive Ion Beams working group was formed. This working group concluded that the experimental halls with the highest priority for modification in order to receive high-intensity beams from SPIRAL2 are G1 and G2. Studies for these changes will have to be pursued in parallel since they lead notably to an expansion of G1 at the expense of G2. The expansion of G1 is required in order to be able to rotate the VAMOS spectrometer to angles greater than currently possible for experiments using heavy SPIRAL2 beams. Consequently, one of the two beam lines in hall G2 will be removed, increasing the space available to accommodate experiments using gamma multi detectors such as AGATA in the best possible conditions. It should be noted that presently neither G3 nor D3/D4/D6 are being considered for the use of high-intensity beams.